HIGH RESOLUTION ACQUISITION AND PROCESSING OF BINOCULAR MICROSCOPIC IMAGES FOR QUALITY ASSURANCE OF FOOD

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Abstract: An efficient algorithm to segregate and provide grades for the meat based on its quality. Incipiently presenting the methods of germ analysis, the challenges and solutions in software development are pointed out. Binocular microscope and microscopic camera are used for image acquisition. For image processing, NI Vision Assistant tool and LabVIEW software are used. For differentiating the bacterial cells (bacilli and cocci), the threshold values are varied accordingly. To determine the average count of the cocci and bacilli bacterial cells, the particle analysis tool is being used.

I. INTRODUCTION
Possible health threats caused by spoilt food is an up-to-date and important issue to many consumers. Research in applications of image processing is intensively done worldwide for guarantee and optimization to quality and safety of food products. The advantage of this technology is the very short response time of an image processing system utilizing for quality assurance of food. The focus point at this stage is set on the retrieval of two types of bacteria: cocci and bacilli bacterial cells in meat samples. Initially the gram staining process is performed in the laboratory and the required images are captured using binocular microscopic setup. In this gram staining process, the chemical dyes are used for differentiating the bacterial cells. From different magnifications of the binocular microscope, the suitable magnification for capturing the image is chosen. The images are then fed into the Vision Assistant tool. In this tool the images are processed based on certain criteria such as brightness, threshold, colour plane extraction, basic morphology, particle analysis, etc.

II. PROPOSED SYSTEM
In our proposed system, we have performed certain processes which are as follows:
1. The gram staining technique to highlight the infective bacterial cells in the meat sample.
2. To view the growth of bacterial cells through the binocular microscope.
3. The images of the grown bacterial cells are captured using microscopic camera.
4. A suitable algorithm for the captured images are developed using Vision Assistant tool.
5. The particle analysis of the infective bacterial cells is done using LabVIEW software.

III. METHODOLOGY
1. GRAM STAINING:
In this process, we have chosen three different states of meat samples namely fresh, frozen and meat that has been exposed to the environment for a whole day. The samples are cut into small chunks that are to be placed into the petri plates. Initially the petri plates are made sterile by exposing them to UV rays. The nutrient medium is prepared by boiling 0.65 grams of agar with 70ml of distilled water. The nutrient medium is then poured into the petri plates and the meat samples are inoculated into it. Then the petri
plates are sealed and then placed into the incubator. After 6 hours, the bacterial colonies are scraped using a needle and smeared on to the glass slide. To heat fix the organism glass slide was gently passed through the flame. The smeared glass slide is then proceeded with gram staining technique. The smears stained with crystal violet for 2 minutes and slide was washed in slow running water. Iodine was added and retained for few minutes which from crystal violet iodine complex and its again wash with the decolourizing agent alcohol was added and the slide was washed after 30 seconds. Then the slide was again washed slow running water. The counter stain safranin was added and washed with water after 2 minutes. Slides were observed under binocular microscope after drying.

2. IMAGE CAPTURING:
2.1 Binocular microscope:
A binocular microscope is any microscope that possesses two eyepieces for viewing a subject that needs to be studied at a high degree of magnification. The parts of the binocular microscope are the eye piece (ocular), mechanical stage, nose piece, objective lenses, condenser, lamp, microscope tube and prisms. Among different magnifications, the magnification of 100x is chosen to view the bacterial cell. Generally bacilli and cocci are two types of harmful bacterial cells that are present in the meat samples. Each sample is viewed separately under the microscope.

**SPECIFICATIONS OF BINOCULAR MICROSCOPE**

- Binocular head side top type 30° inclined; 360° rotating
- Coaxial coarse and fine knobs; tension adjustment on the right side.
- Wide field eyepieces W/F 10X/20mm; One with pointer (Optional)
- Reverse mounted quadruple revolving nose piece
- Objective achromatic E-F N plan (Antifungal) 4X,10X,40X,100Xxaxis
- Focussable Condenser NA 1.25 abbe condenser with iris diaphragm slider slot. Focussable and lockable.
- Stage movement (XY direction) on rack and pinion.
- LED illumination 3W with intensity control >10,000hrs bulb lifespan with battery backup of 1 hrs.
- Attachable mirror set.
- Wooden box with lock for storage.
- Other essential accessories, oil, lenses, cleaning solution, dust cover.
- Technical final approval after demonstration.

2.2 Microscopic camera:
A microscopic camera allows you to view a live image from your microscope directly on an LCD projector or computer. The microscope cameras include software that allow capturing both still images and video and making measurements.

**Figure(a):** Binocular microscope

**Figure(b):** Chemical dyes namely crystal violet, iodine, safranin and 95% ethanol.
3. IMAGE PROCESSING:

3.1 NI Vision Assistant tool:

The captured images are fed into the Vision Assistant for further processing. Vision Assistant is a tool for prototyping and testing image processing applications. To prototype an image processing application, build custom algorithms with the Vision Assistant scripting feature. The scripting feature records every step of the processing algorithm. After completing the algorithm, you can test it on other images to make sure it works. The algorithm is recorded in a script file, which contains the processing functions and relevant parameters for an algorithm that you prototype in Vision Assistant. Separate algorithms are generated for cocci and bacilli bacterial cells. The steps performed in this tool are explained below:

- **Brightness**
- **Color plane extraction**
- **Threshold**
- **Basic morphology**
- **Advance morphology**
- **Particle analysis**

**Brightness:**
This step is done to brighten and highlight the boundaries of the bacterial cells.

**Color plane extraction:**
In this step, the primary colors (RGB) are converted to grey color where the resultant grey image will be the average of the RGB colors.

**Threshold:**
In this process, the range of pixel image is (0-255) a wide range of values are identified. This step is done to differentiate the cocci and bacilli bacterial cells with a higher resolution. The threshold value varies for each type of bacterial cells.

**Basic morphology:**
In this process, two types of methods are used “Dilation and Erosion”. In dilation process the foreground colour will be white and background colour will be black, in erosion process the foreground colour will be black and the background colour will be white.

**Advance morphology:**
In this process, the colonies of bacterial cells that are difficult to taken into account are eliminated.

**Particle analysis:**
This step is done to get the approximate count of the cocci and bacilli bacterial cells. The other
parameters such as area, width and thickness are also obtained through this step.

3.2 LabVIEW Software:
Using the LabVIEW VI creation wizard, you can create a LabVIEW VI that performs the prototype that you created in Vision Assistant. Laboratory Virtual Instrument Engineering Workbench (LabVIEW) is a system-design platform and development environment for a visual programming language from National Instruments. From the LabVIEW VI created for the previous generated prototypes, the approximate count of the bacterial cells, area and thickness can be obtained easily. The necessary algorithm will be implemented in the block diagram window. The results will be displayed in the front panel window. Figure(f) represents the front panel window with the executed results.

IV. BLOCK DIAGRAM
The block diagram of our paper is given below:

![Block Diagram](image)

In this block diagram, the food sample represents the three states of meat we are taking. The gram staining technique is performed over the meat samples and are viewed under binocular microscope. The images are captured using microscopic camera and the images are stored in the computer for future purpose. The microscopic

are then fed into the Vision Assistant tool and the necessary algorithmic script is developed. Later a LabVIEW VI for the generated script is created.

V. RESULT
The following figure represents the output of our paper which is shown here.

![Figure(e)](image)

Figure(e) Front panel window indicating the count of bacilli bacterial cells in the fresh meat sample.

![Figure(f)](image)

Figure(f): Front panel window indicating the count of bacilli bacterial cells in frozen meat sample.
VI. CONCLUSION
This paper has proposed an efficient technique for the quality assurance of food which will be useful for the consumers. We are trying to create awareness among the people highlighting the drawbacks of consuming frozen meat that are available in the super markets. By comparing the results of the frozen and spoilt meat, we can conclude that frozen meat is merely a harmful product that are available to the consumers in attractive packets and containers.

VII. REFERENCES


